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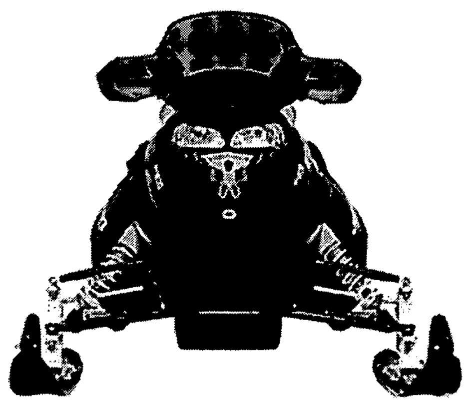
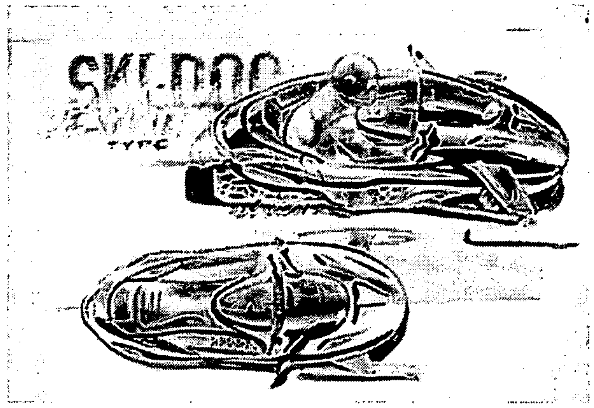
The Making Of The SKI-DOO REV

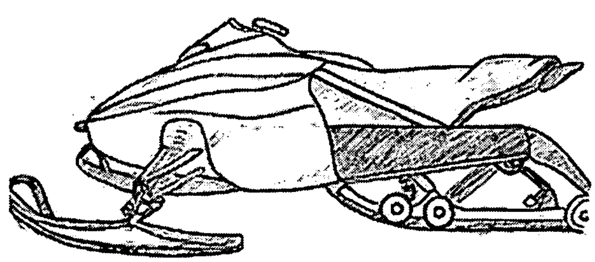


Can a new snowmobile truly be designed with "no boundaries"? That is in essence the mission of the Ski-Doo Advanced Concepts Team. The Advanced Concepts Team (ACT) is an assembly of designers, technicians, engineers, modelers, and CAD engineers that perform everything from sketching to building working prototypes of conceptual products. Their job is to explore new concepts, segments and features. The key here is that anything goes – feasibility is not to be considered – not here. The ACT is not connected to engineering, an important freedom so they can be free to create without thinking about how to get it mass-produced. That is someone else's job.

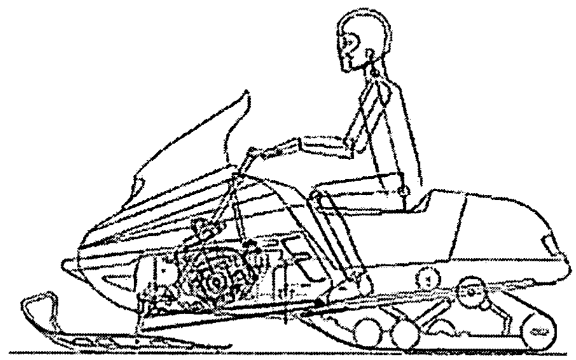


With the Ski-Doo Advanced Concepts Team, anything goes. Feasibility is not to be considered – they are free to create without thinking about how to mass-produce it.

The Advanced Concepts Team was formed in 1995, originally as a design group for the Sea-Doo watercraft, based in Florida. Their first feature to actually see production was the suspension seat on the Sea-Doo XP and HX models. Shortly after their formation, Vice President of Design Denys Lapointe was asked to move back to Valcourt and also design the Ski-Doo snowmobiles. Denys agreed, but under the condition that he could form an Advanced Concept Team for snowmobiles.
It was 1996 when the Ski-Doo ACT was formed. Two of their members, technician Berthold Fecteau and engineer Bruno Girouad, started sketching a vehicle that put the rider in a better position to match the stand-up riding style of Finnish snocross sensation Toni Haikonen. Fecteau was an avid snowmobiler, riding since the age of ten, and had built plenty of snowmobiles over the years. Girouad, on the other hand, considered to be a suspension and vehicle dynamics genius, had little (if any) snowmobile experience but was an experienced motocross rider.



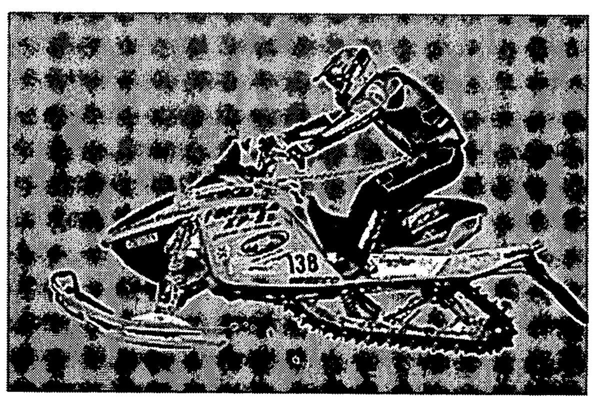
Advanced Concepts Team members Berthold Fecteau (Technician) and Bruno Girouad (Engineer) started sketching a vehicle that put the rider in the right place before building their first model.

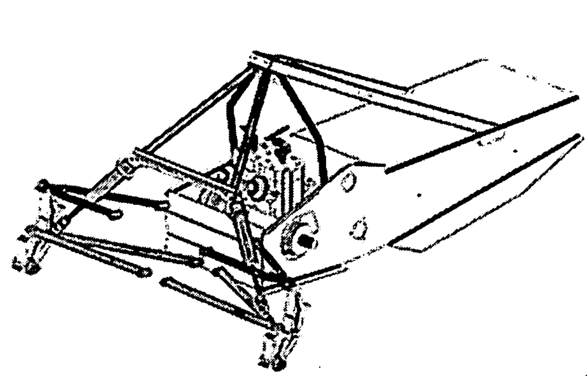


The very first design layout of the REV (1996).

Fecteau had already built a "driver forward" machine for himself in the 1970s, and continued to believe there was merit in the basic design. The ease of maneuverability from the centered masses and the isolation from the bumps were strong motorcycle influences. Fecteau wondered why snowmobilers continued to sit on the back of the sled, especially when the trail got so rough. Why not position the rider in the center of the vehicle like a motocross rider?

Fecteau asked Bruno this exact question, "Why don't we try that for a snowmobile?" Bruno agreed, but at that time there was no budget for the project. They had their hands full with other Advanced Concepts projects, but the two believed in the potential so much they did sketching and computer analysis in their spare time. When things got slow, they enlisted the help of a few mechanics started to build a prototype – on the side. During lunch, after work, anytime they could fit it in, with no "official" support or money for the project! They used scrap parts from the junk pile. Components left over from durability testing were used to first build their idea. A seat and a hood from a Sea-Doo, tunnel from Ski-Doo, picking and choosing.

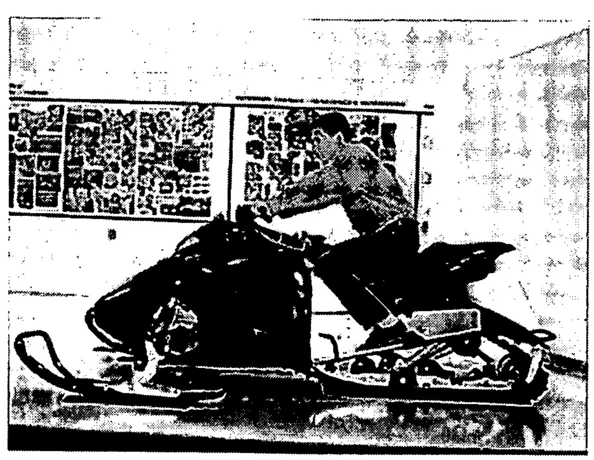




After evaluating all types of suspensions, it was decided the best handling sled for aggressive riding and rough trails was the A-arm front suspension. In order to overcome the increased bump forces focused on the bulkhead, designers added a 10-degree rake to the A-arms and distributed the forces through a pyramidal chassis.

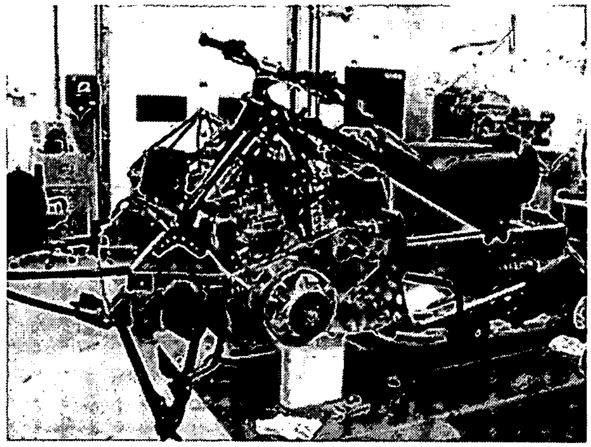
They knew what kind of vehicle they were after; more of a Porsche, with nimble and responsive handling, not the lengthened chassis of the triple-triples of the day. The idea of the centered rider was front and center. Inspired by motocross bikes, street bikes and ATVs (newly reaching manufacturing at Bombardier) they quietly proceeded with their "pet" project.

One thing they were bent on changing was the trailing arm front suspension. Remember, one of the key elements they operated under was no limitations! This meant using the benchmark front suspension in everything from cars to ATVs to the better handling snowmobiles of the day, the A-arm front suspension.



Early prototypes had little "windshield"

due to their heavy motocross influence. This original prototype was called "Café Racer"

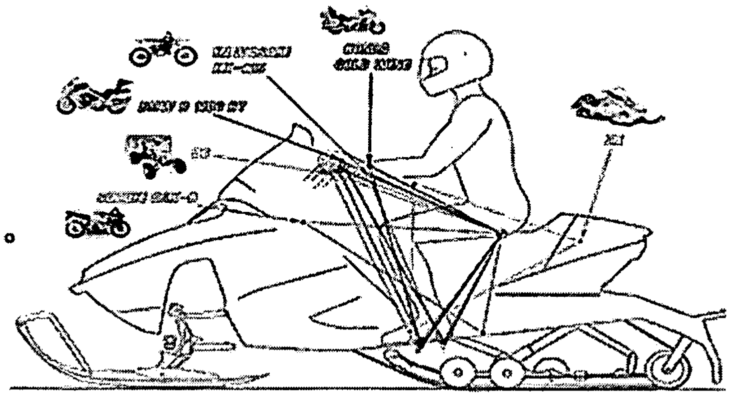


One day in the summer of 1997, Denys Lapointe, Jose Boisjoli, president of the Ski-Doo division, and Pierre Beaudoin, president of Bombardier Recreational Products, were reviewing the projects in the Advanced Concepts studio. They noticed a machine stashed under cover. Asked what was under there, Fecteau and Girouard removed the cover and explained their concept. Pierre Beaudoin, intrigued with what he saw, sat on the radically different sled. "That's nice," stated Beaudoin. "I want to try that next winter."

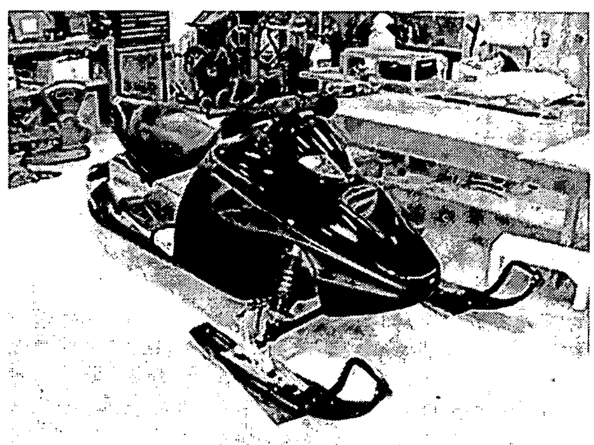
With that simple statement, their side project just became an official Advanced Concepts project. For the next two years the entire team worked on refining the project. They built additional, more refined prototypes, now with input from a more diverse group of minds, including Dany Garand (now with Audi designing the A8), Germain Cadotte, Advanced Concepts Team stylist, and Jean Guy Talbot, Advanced Concepts Team Leader (now retired).

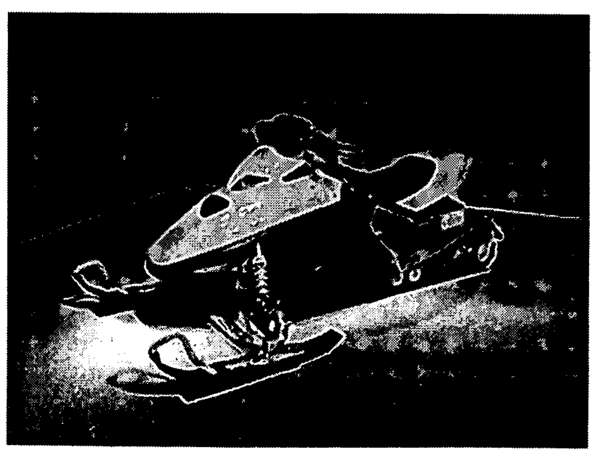
Features were added, things like motocross handlebars, the hinged rear snow flap and the radical seat design. Over the course of the next two years, four different prototypes were built just to convince people the project had merit.

Their concept of starting with the driver in what they considered to be the right place to begin with, and then designing and placing all of the mechanicals around the driver, was pretty much the opposite of how it had always been done. Not only was driver positioning important, but so was mass centralization to arrive at the desired handling response.



The single biggest problem with traditional driver placement on a snowmobile compared to other forms of personal vehicles was that the hips were positioned parallel to or slightly below the knees.

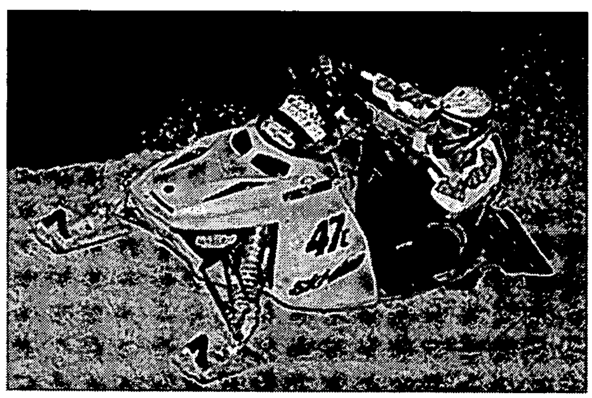


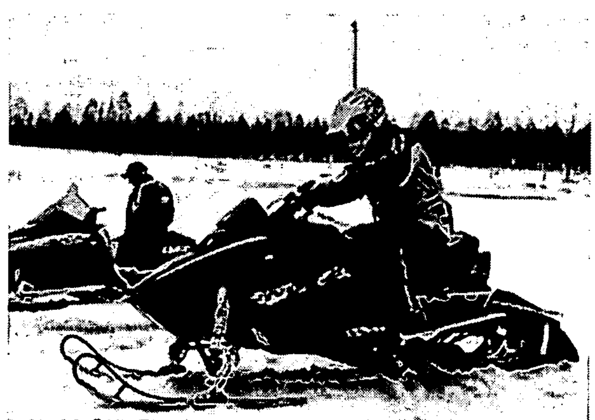


Three more hand-built prototypes were assembled before the project saw the

green light in May of 1999 to be developed as a consumer sled.

They quickly realized the first step in all snowmobile designs, placement of the engine and the driver, had always been wrong. Could the wrong turn could be traced back to when the engine placement had been moved from the middle of the sled on top of the tunnel (late 60's) to down in the nose of the belly pan in the 70's?
For years, the emphasis had been for a low center of gravity and the exacting cornering it provided. In pursuit of this, manufacturers stayed with low-to-the-ground suspensions. Even as suspension travel started to inch higher, the driver was actually lowered on some sleds in an effort to maintain a lower center of gravity for handling. As suspensions improved, the riders' ability to cover rough terrain improved, to the point the riding styles started to mimic that of motocross riders. As soon as riders started to transition from sitting to standing, the "problem" became too great to ignore - the hips were positioned below the knees. The hip joint had always been positioned parallel to, or slightly below the knee joint. This is very significant; in this position, in order to lift yourself up off the seat (for bumps) the rider is forced to use their arms and upper body to bench press their entire body weight every single time they wanted to lift their butt or stand up! Over the course of a hundred mile ride, this position became very tiring.





The face of snowmobile racing was slowly changing from one of cornering and handling on smooth oval tracks to a form of racing called snocross, where standing up through the bumps and taking on jumps were the performance attributes that replaced the high speed cornering capabilities. Just like what works at Indy is far different than what works out on the Baja, snowmobile designs that were honed for smooth oval racing were not ideal for butt-raising terrain.

They realized that to build a better sled they needed to start with the rider; the joints and the muscles, not nuts and bolts. The solution? Move the rider forward, way forward, and position the hips so they're higher than the knees. Like a motorcycle. When Beaudoin rode the first mule that next winter after seeing what lay beneath the sheet in the ACT shop, he said' "There's something there." The ergos on that first mule weren't quite right, but the potential was.

At that time, most every snowmobile being built was the same as any other. Sleds were getting too similar, too boring. Beaudoin himself pushed hard for this sled because everything being offered was too similar.

"If you create a snowmobile that drives like no other, it must look like no other," stated Germain Cadotte, ACT Team Leader. "This is the first snowmobile to use "edge" design – wrapping planes around the mechanical package and sharp creases, "Cadotte explains. The REV is the first sled styled with a unified look. The seat, tank and console are integral to the entire design, not separate elements. The lines in the sled converge at a point behind and above the seat, so the REV looks fast even when it's standing still.

Three more hand-built prototypes were assembled after that first mule before the project saw the green light in May of 1999 to be developed as a consumer sled. The decision to bring to production such a radical vehicle and invest millions, at extreme risk, started at the top. It was, of course, a calculated risk, and a brave one.

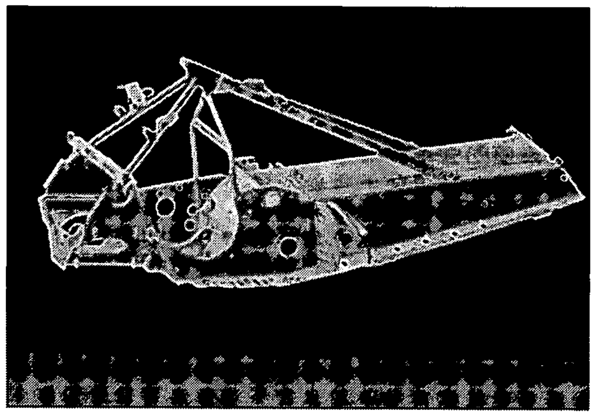
Once the decision had been made to for-real bring the REV to market, the project left the hands of their creators in the ACT and was brought to the engineering, design and marketing teams. Hand-built concept sleds had to be made producible, marketable, and usable in the hands of the consumer.

They started with an aggressive weight target. Early on, the Valcourt Race Shop was brought into the fold and their insight sought. They were asked what they did to Open Mod sleds to reduce the vehicle weight, system by system. Other than drilling holes everywhere, Marecel Imbeault, Race Shop Manager, told them, "If you want to remove weight, remove ALL of the steel. Before exotic materials, remove all of the steel. Aluminum is not that much more expensive than steel, especially if you design it in the first place with aluminum." The first (P1) prototype had been made of many steel components, but with the second version (P2) prototype the decision to go all aluminum (and get rid of the steel) had been made.

One of the defining influences during this critical stage of development was Robert Handfield, Engineering Project Leader for the REV. He was (is) an avid snowmobiler and motocross rider. Being experienced at riding both types of vehicles, Handfield was helpful in bridging the gap between the classic battles of design vs. engineering. Designers want it to look one way, engineering needs it to work and be able to assemble it on a production line (and at a profit, that is the basic goal).

Engineering had to work hard to reduce the weight on the skis, the lean in the corners, and the functionality of the vehicle. The first version ergos were too much like a sport bike, with everything still stretched out too far due to the handlebars being too far forward. Handfield insisted on changing the handlebar ergonomics, wanting the handlebars closer to the driver.

The big difference between bikes and sleds was that on a bike, when you lean the bike leans. On a sled, when you lean the sled doesn't lean. With the outstretched sport bike riding position, it was more difficult to lean because the arms were already stretched out. The ideal ergo target, Handfield argued, was to bring the hands closer to the knees for better maneuvering. "That's what people are doing when they ride up on the tank'" he argued. "Plus, it's a scary feeling trying to lean when you're stretched out", something later reinforced by internal clinics. The far-forward positioning of the handlebars also placed too much weight on the skis, making it harder to steer.
The next version maintained the forward rider seating position, but brought the steering back towards the rider. Better ergos, reduced steering effort, problems solved. This made the vehicle react more like ATVs and motocross bikes, easier to maneuver and with a better balance.



Every part on the REV platform, including the A-arm front suspension and pyramidal frame, is engineered using state-of-the-art computer-aided design (CAD). Along with advances in rapid-prototyping, this technology enables Bombardier to develop new platforms and features faster than ever. "You ain't seen nothing yet!"

All the way along, the prototypes endured testing. Wicked testing. Testing is necessary to not only prove the concept, but to also determine durability and then calibration. In April and May of 1999, Finnish racers Janne Tapio and Tomi Ahmasalo rode the P-0 prototype in Quebec. The following winter, they both tested the P1 prototype in Finland, running the machine through a battery of durability and functionality tests.
Discreet and confidential testing sites were important to the team, as the majority of testing was done in remote locations with camouflaged units. Jose Boisjoli, president of the Ski-Doo division of Bombardier, wanted to ride the P-1 prototype but didn't have enough time to go to the remote test facility, so the decision was made to take a quick ride right out of Valcourt. Three riders took off from Jose's house, riding in the afternoon one day. Some other riders saw the P-1, thinking "Wow, what's that?". Turning up the wick to avoid detection, one of the riders blew a corner and got stuck

in deep snow. Luckily, they got the sled out and disappeared before the "consumers" caught up with them, but they realized the P-1 had too much weight too far forward to work well in deep snow. This episode helped contribute to the revisions in the P-2 prototype to redistribute the weight.

It was these P-2 prototypes that Ski-Doo racers Todd Wolff and D.J. Eckstrom were called upon by Handfield to evaluate. After the 2001 Grand Prix race event held in Valcourt, the racers stayed in town and raced camouflaged P-2 prototypes around the snocross track, double-jumping and getting big air. Both drivers were consistently seeing lap time improvements. Racing each other and trading off, one on a REV and one on a then-current ZX racer, the rider on the REV was consistently faster by at least one second. Here and at Ski-Doo's secret northern test facility, riders commented on how they felt so much more in control, and here's the biggest single difference for trail riders; they were much less tired after riding the REV. It was hard to believe how much faster they could ride!

The first "production" REVs were the Open Mod race sleds that terrorized the snocross courses in the winter of 2001-2002. Even at that time, the public didn't fully realize they too could be riding a sled like that the very next year. In December of 2001, a small group of snowmobile journalists were flown to Utah to get their first taste of what the future of Ski-Doo trail sleds held. In January of 2002, all snowmobile media had the chance to ride the REV in Quebec, on actual groomed trails. These sleds were of a small group of a few hundred prototypes, many of which made their way into the hands of Ski-Doo dealers and eager consumers lucky enough to spend a few miles on one at various demo rides. SnowTech Magazine was hand-picked to receive one of these sleds, serial number #000004, and proceeded to perform their own evaluation and durability testing for 4412 miles before the snow melted. Their conclusion? Here is what SnowTech Magazine test riders and editors had to say about the REV after riding their prototype for over 4,000 miles;"There is a difference between an evolutionary change and a revolutionary change. What we have here could very well be the single most significant advancement in how a snowmobile is ridden."

"Some riders will be impressed with the new front suspension, or the futuristic look of the machine. This sled is all about the rider position. – it changes the way the rider interacts with the machine. The REV truly takes snowmobiling to a new level."

"The REV changes the rules. It makes you wonder why you've been sitting so far back on the machine like we have for so many years."

"The REV is so totally different that Bombardier can rightfully can claim they've re-invented the snowmobile."

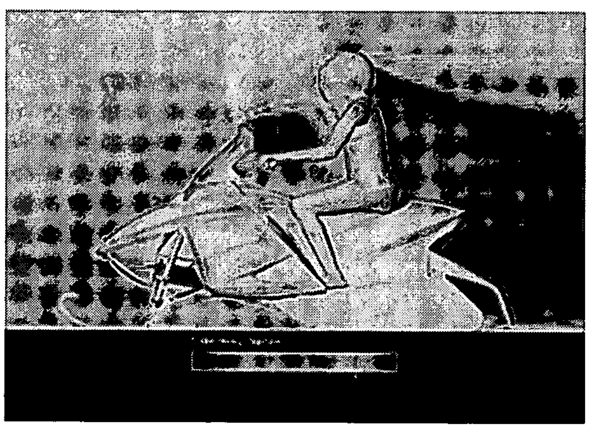
Well said.

Welcome to the twenty-first century.

Wind Tunnel Testing & Simulations

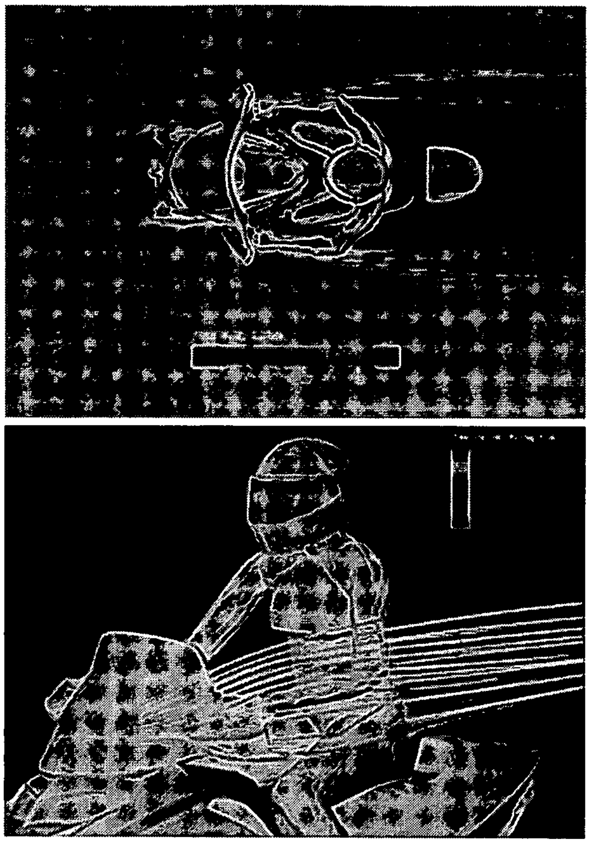
In addition to extensive wind tunnel testing, Ski-

Doo engineers evaluated the REV's aerodynamics using sophisticated computer simulations. One of most difficult parts of the REV development process was the balancing act between function and design. The challenge was to find the right balance between wind protection, top speed and a design that communicated lightness. Rider protection was at odds with top speed drag, as a 1/2" change in windshield shape makes a BIG difference! Other considerations included the styling, underhood airflow and high-speed stability. The first wind tunnel testing took place at the University of Sherbrooke, using a small wind tunnel. Four full days were spent evaluating, benchmarking and redesigning, using a smoke trail and a car antenna with leather shoelace on it to evaluate air flow.



Ski-Doo engineers evaluated the REV's aerodynamics using wind tunnel testing and sophisticated software simulations.

The first designs were very "motocross/snowcross" inspired and had little wind protection. They discovered quite early that they HAD to put a real windshield on it. Different windshields were evaluated, and the first windshield wasn't connected to the handlebars (like the Open Mod racers). Different noses were tried, and small deflectors/fins were evaluated to provide better wind protection. Air deflector fins were cut out of sheet metal and taped on the sled in the wind tunnel



Ski-Doo's CAD wind-testing software has incredible capabilities, displaying colors and "threads" indicating areas of drag.

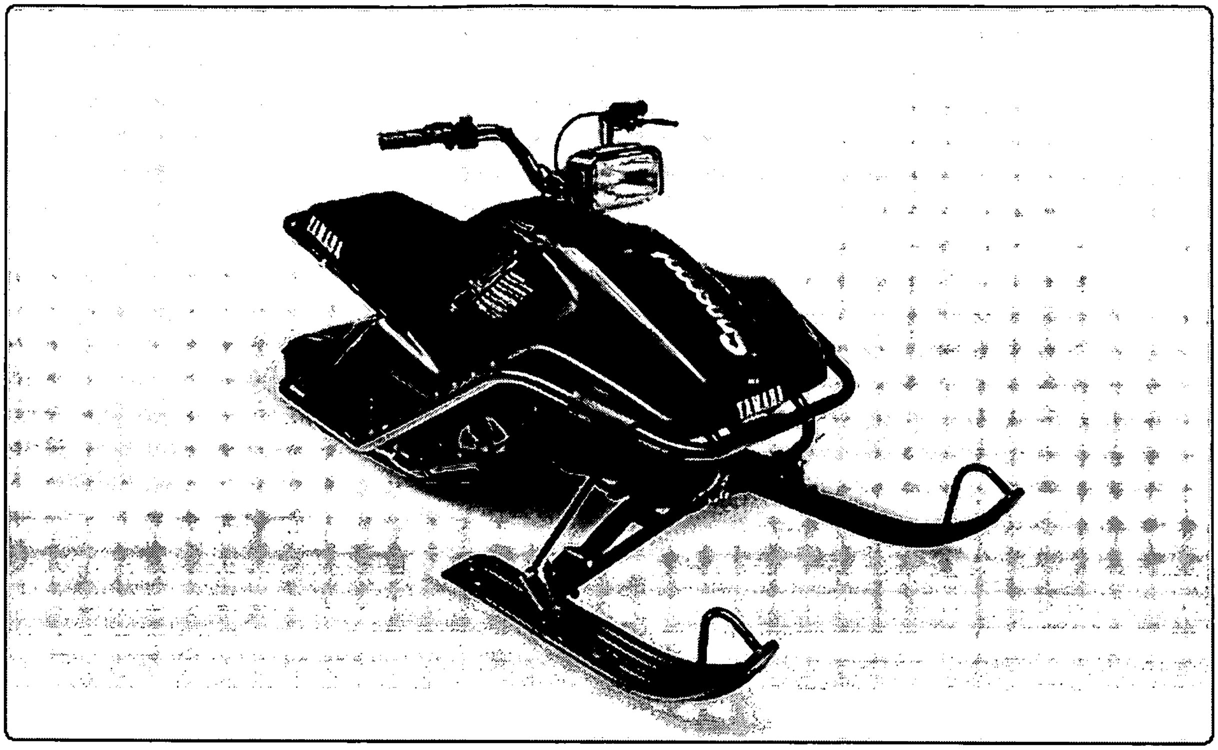
for evaluation.

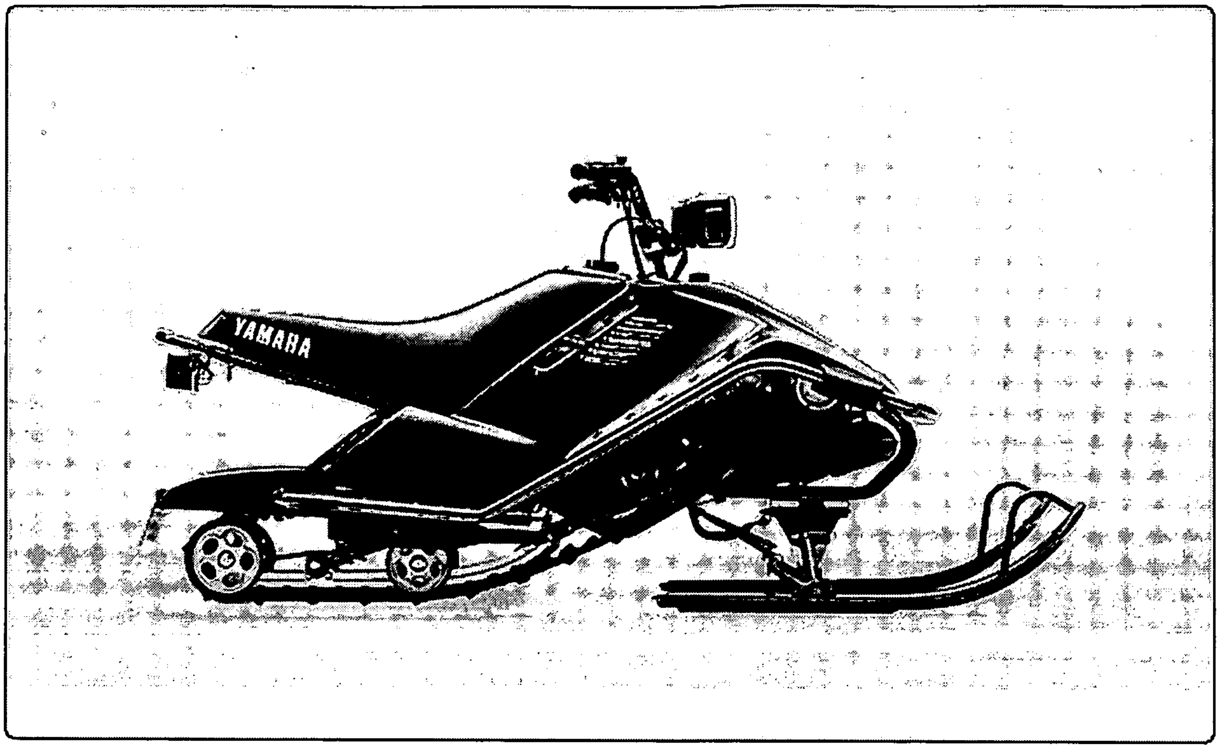
This first session resulted in having to restyle the lines of the entire vehicle to accommodate the "new" wind protection. The entire headlight and instrument pod had to be redesigned. It took a lot of work to make the concept reality.

Ski-Doo started using a new CAD wind-testing system in 1999, in-between the P1 and P2 prototypes. While designed for cars and motorcycles (not mach-speed airplanes), they wanted to determine if it would work for snowmobiles. The system was benchmarked with the ZX platform, and it worked AWESOME!

Now, new product development starts with software, and ends up in a tunnel. The CAD wind-testing system has incredible capability with different driver positions, sizes, cross-sections, pressure, and airflow patterns, displaying colors and "threads" indicating areas of drag.

Final wind tunnel testing of the REV took place in a huge tunnel at the General Motors facility in Ottowa. This session was basically to test the vehicle dynamics, making sure it didn't take off (lift) and evaluate different suspension levels, seating positions, and to determine the coefficient of drag.

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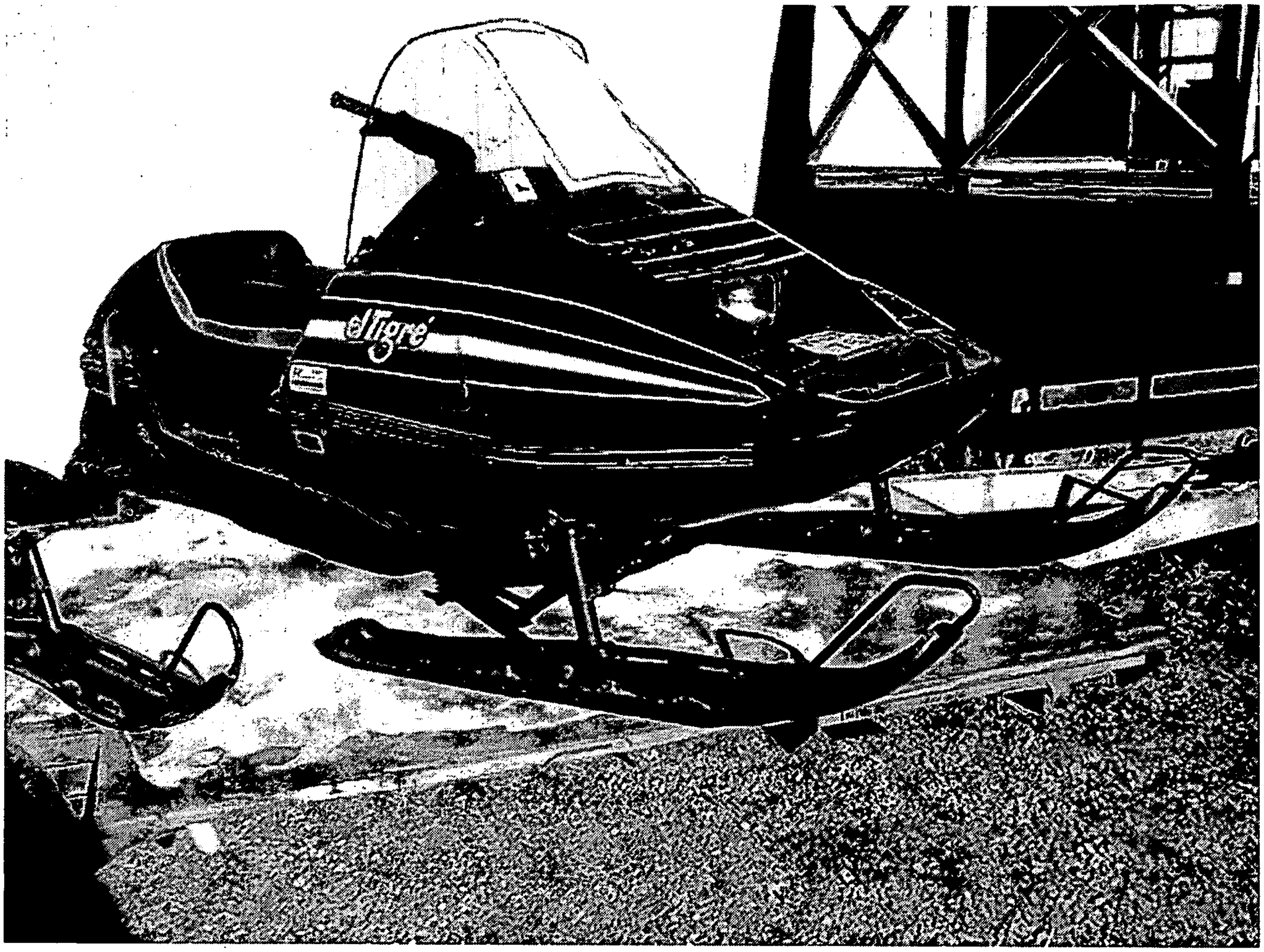
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Mätarställning: 870 mil
Skick: Begagnad
Pris: 18500 kr
Typ: Sport

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Husvagnscenter i Valbo AB
Ludvigbergsvägen 16
818 31 Valbo
Tel: 026-130250
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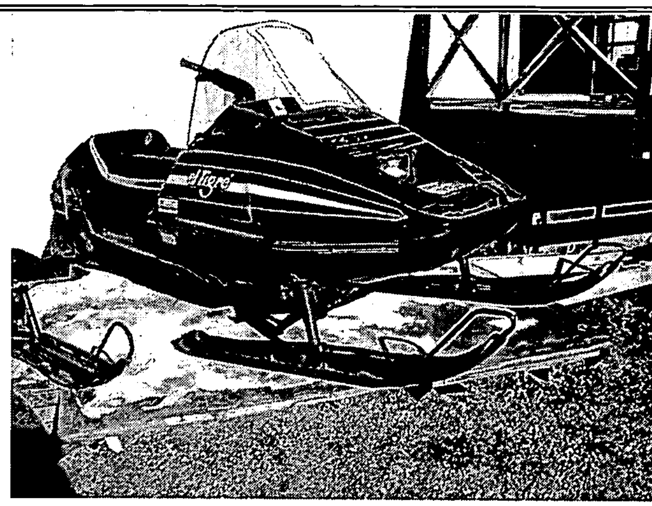

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